On June 8th, the secondary condensation was very faint, and in consequence the settings are somewhat uncertain. The following measure was made with the 36-inch refractor:—

June 9.89 149°.0 16″.9

On this date it was noted as "an extension of (brighter) nebulosity from the nucleus rather than a separate condensation."

On June 26th, the comet had become very faint, the entire comet not brighter than 10th magnitude. The nucleus was estimated at 12–13th magnitude.

From the above observations, it is evident that the nucleus of the comet brightened up materially prior to June 4th, when an elongation of the brighter nebulosity surrounding it took place, and that after this secondary condensation was formed the nucleus rapidly faded. It is probable that the general course was much the same in the first case of the formation of a secondary nucleus, about May 6th. I have no observations bearing on the case prior to that date; but my subsequent observations show clearly the rapid loss of light after the separation of the two nucleii. It seems reasonable to suppose that there was some physical connection between the brightening of the nucleus and the appearance of the two separate condensations.

LICK OBSERVATORY, UNIVERSITY OF CALIFORNIA, July 25, 1899.

OBSERVATIONS OF SWIFT'S COMET (1899 *a*) FOR REFRACTION.

BY C. D. PERRINE.

Observations were made on May 18th and June 9th with the 36-inch refractor, to detect if possible any refractive effect on the light of a star passing through the cometary matter. On each date two stars were selected in advance of the comet, so that the nucleus would pass between them. The stars were so chosen that the light from both would have to traverse the cometary matter on opposite sides of the nucleus. In this way any effect of refraction on one star would be *added* to a similar effect on the other star. The distance between the stars was measured before, during, and after the transit of the comet.

Following are the results of the measures after having been corrected for differential refraction:—

1899, May 18.—POSITION-ANGLE AND DISTANCE OF TWO STARS OF 13.5 MAGNITUDE.

Mt. Hamilton Sidereal Time.	Angle.	Distance.
$17^h\ 53^m\ 19^s$	$38^\circ.36$	....
17 58 9	....	203″.40
18 7 53	....	203 .41
18 14 17	....	203 .45
18 25 30	38 .08	....
18 29 43	....	203 .63
19 18 39	38 .20	....
19 23 4	....	203 .37

The comet transited a line joining the stars at $18^h\ 8^m$, at which time star *a* was 78″ and star *b* 125″ from the nucleus. The head of the comet was 174,000 miles in diameter; and hence the light of the two stars traversed cometary matter, as follows:—

Star *a* . . 168,000 miles
b . . 158,000

1899, June 9.— POSITION-ANGLE AND DISTANCE OF TWO STARS OF 10TH MAGNITUDE.

Mt. Hamilton Sidereal Time.	Angle.	Distance.
$17^h\ 3^m$	$178^\circ.95$	....
17 8 6^s	. ..	219″.87
17 22 53	....	220 .07
17 37 6	....	220 .03
17 53 6	...	220 .03
18 50 6	....	220 .06

The nucleus of the comet passed between the stars at $17^h\ 41^m$ at the following distances:—

From star *a* . . 130″.1
b . . 89 .9

The head of the comet was 145,000 miles in diameter. The light from the stars passed through 122,000 miles of cometary matter for star *a*, and 134,000 miles for star *b*.

At the time of the first sets of measures in each case the stars were involved in the nebulosity of the comet to some extent, but the last measures were wholly free from it. The differences between the various sets of measures are small, and there is no indication in them of any systematic variation due to refraction. The dia-

grams will make clear the relative positions of comet and stars at the times of measurement. The circles represent the fields of view.

Dr. M. W. MEYER made observations at Geneva of the great comet of 1881 (1881 III), from which he deduced an appreciable refraction.*

In 1891, Professors BURNHAM and BARNARD made observations at the Lick Observatory of WOLF'S comet for this purpose.†

Professor BURNHAM'S measures show a slight systematic variation, but in the opposite direction from what is to be expected upon the most probable assumption of the variation of density in the comet. Professor BARNARD'S observations show no systematic deviations.

LICK OBSERVATORY, UNIVERSITY OF CALIFORNIA, 1899, July 28.

THE RADIANT POINTS OF METEORS.

BY W. H. S. MONCK.

In a paper read before the Astronomical Society of the Pacific, in November, 1892, I contended that all, or almost all, meteor-radiants were of the stationary or long-enduring kind, and that the current theory which required them to shift their position in the heavens every night during the continuance of the shower entirely failed to explain the facts. "A General Catalogue of Meteor-Radiants," by Mr. DENNING, has just been published in the fifty-third volume of the "Memoirs of the Royal Astronomical Society." Mr. DENNING is probably both the greatest living observer and the greatest collector of observations of meteors, and his tables, I think, bear out the views which I expressed nearly seven years ago to the fullest extent.

Mr. DENNING reduces all radiants hitherto observed to 278 centers. But owing to the paucity of observations made in the southern hemisphere, there are perhaps thirty of these of whose persistency or otherwise we have at present no reliable information. Omitting these, it will be found that in the vast majority of cases meteors come from the same radiant for more — often for much more — than a month in succession without any perceptible variation in the radiant. Thus, taking the first twenty of Mr. DENNING'S centers of radiation (which he places in order

* *Astronomische Nachrichten*, No. 2471. † *Astronomische Nachrichten*, No. 3072.